DOCUMENT RESUME

ED 263 905 IR 011 893

AUTHOR Bangert-Drowns, Robert L.
TITLE Meta-Analysis of Findings on Computer-Based Education with Precollege Students.
PUB DATE 85
NOTE 8p.; Paper presented at the Annual Meeting of the American Educational Research Association (69th, Chicago, IL, March 31-April 4, 1985).
PUB TYPE Information Analyses (070) -- Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Academic Achievement; *Computer Assisted Instruction; *Conventional Instruction; Elementary Secondary Education; Instructional Innovation; *Intermode Differences; Literature Reviews; *Meta Analysis; Microcomputers; *Student Attitudes; Teaching Methods; Use Studies
IDENTIFIERS *Instructional Effectiveness

ABSTRACT

A quantitative or meta-analytic review was conducted of studies comparing computer-based education (CBE) to conventional instruction in precollege classrooms. Seventy-four studies were included in the review; sources included earlier reviews by Hartley, Burns, and authors from the University of Michigan, and the ERIC and Comprehensive Dissertation Abstracts databases. Remaining studies were found through bibliographic references in the collected articles and reviews. It was found that the average effect of computer-based instruction was to increase student test performance from the 50th to the 63rd percentile. Effects were most consistently high for computer-assisted instruction (drill and practice, tutoring) followed by computer-managed instruction and computer-enriched instruction; effects were also higher in published than in unpublished studies. In addition, CBE positively influenced student attitudes toward the course content and the computer. A list of references completes the document. (Author/JB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED263905

Meta-analysis of Findings on Computer-Based Education with Precollege Students

Robert L. Bangert-Drowns
The University of Michigan

Paper presented at the annual meeting
of the American Educational Research Association
Chicago, 1985

IR011893

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Robert Bangert-Drowns
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Abstract

A quantitative or meta-analytic review was conducted of studies comparing computer-based education (CBE) to conventional instruction in precollege classrooms. Seventy-four studies were included in the review. The average effect of computer-based instruction was to increase student test performance from the 50th to the 63rd percentile. Effects were most consistently high for computer-assisted instruction (drill-and-practice, tutoring), followed by computer-managed instruction and computer-enriched instruction. Effects were also higher in published than in unpublished studies. CBE positively influenced student attitudes toward the course content and student attitudes toward the computer. With continuing improvements in computer software and hardware and with growing sophistication in the ways computers are used in classes, one could expect the already positive record of CBE to improve.

Educators no longer ask whether computers will have a prominent place in the curriculum. Parents, students, and teachers agree that contemporary instruction must prepare the student for life in a technological world and the presence of computers is increasingly seen as a mark of a school's adequacy. For educators the question now is how the computer can be best related to instruction. Should instruction be only about computers or should it also be through computers? And if computers are used to instruct, how is this to be done? Should the computer, for example, manage test administration and student progress, should it provide rote review, or should it simulate complex situations for the student to investigate?

Numerous researchers have evaluated the effects of computer use on elementary and secondary school students. Outcomes vary greatly among these evaluations but so do numerous significant features such as hardware, software, and research design. It is difficult, therefore, to draw any simple general conclusions from these studies.

Three reviewers applied statistical procedures to review research on computer-based education. In their doctoral research, Susan Hartley of the University of Colorado and Patricia Burns of the University of Iowa agreed that computer-based education (or CBE) typically improved the test scores of elementary and high school students by about 0.38 standard deviations. Our preliminary research at the University of Michigan reported similar findings for high school students.

These earlier reviews are in need of reexamination. They do not represent the most recent research on CBE nor do they employ the most recent standards for research integration. The present review is designed to make up for these shortcomings. This review includes the most recent available evaluations and uses stricter standards to eliminate studies with serious methodological flaws. Included studies represent a variety of CBE applications in elementary and secondary school courses of varying content.

Method

In our review of elementary and secondary school CBE, we used meta-analytic procedures identical to those used in our other reviews. We gathered 500 separate reports from three sources. One group of studies came from the earlier reviews of Hartley, Burns, and our Michigan group. Other studies were found in the ERIC and Comprehensive Dissertation Abstracts databases. The remaining studies were found through bibliographic references in the collected articles and reviews.

Only 74 of the 500 collected reports were suitable for our meta-analysis. These studies took place in actual classrooms in Grades 1 through 12. The studies provided quantitative comparisons of a computer-taught and a conventionally instructed class and were free from serious methodological flaws.

All 74 studies measured achievement test performance after a period of instruction. In addition, 12 studies measured student attitudes toward the course content and 5 studies examined student attitudes toward computers. We transformed these outcomes to effect sizes in order to study their relations to study features.

Results

The collected studies give a very favorable impression of the effectiveness of CBE. Only 10 of the 74 studies favored conventional instruction and only 2 of these (3% of the total sample) significantly favored conventional teaching. On the other hand, sixty-four of the 74 studies (86%) reported higher achievement test scores related to computer-based education. In 39 studies (52% of the sample), the superiority of CBE was statistically significant.

Insert Figure 1 about here

The use of average effect sizes gives a quantitative measure of this effect. The average effect on test scores reported in these studies was 0.33 standard deviations. That is, CBE typically increased students' achievement test performance from the 50th percentile to the 63th percentile. However, there was a good deal of variance in the effect sizes. We hoped that differences in study features might explain some of this variance.

Examining the effect sizes, we first noted that they differed according to instructional level. Effect sizes were higher at the elementary school level. The average effect for studies of Grades 1 through 6 was 0.42 standard deviations, but it was a smaller 0.26 standard deviations for Grades 7 through 12.

Insert Figure 2 here

There were other differences between elementary and high school levels. Computer-managed instruction (CMI)

showed little success at the elementary school level, an improvement of only 0.07 standard deviations. At the high school level, CMI showed gains of 0.40 standard deviations.

Computer-assisted instruction (CAI)--the use of computers for tutoring or drill-and-practice--was successfully used at both precollege levels. In the elementary school, the average effect size for CAI applications was 0.47. The average effect was 0.36 for the secondary school level.

Computer-enriched instruction (CEI) was studied only in the secondary schools. CEI studies used computers as simulators of natural phenomena or as programmable devices to study mathematical formulas. This application was not very effective, however, raising achievement test scores by only 0.07 standard deviations.

Insert Figure 3 here

Perhaps the most common pattern in meta-analysis is the lower effect sizes found in dissertation reports as compared to published reports. This review is not exception. Averaged across instructional level, dissertation studies have an effect size of 0.25, whereas effect sizes in published studies are twice as large, 0.47. The difference was strongest at the elementary level, an effect size of 0.27 for dissertations and 0.57 for publications. At the secondary school level, dissertations were 0.24 and publications were 0.30.

Insert Figure 4 here

A noteworthy finding at the secondary school level was the effect sizes grew larger over the years. Studies published before 1975 showed a small effect size, 0.12 standard deviations. Studies published after 1975 significantly differed ($p < .01$) from their predecessors, showing an average effect of 0.45 standard deviations. At the secondary level, therefore, there was a correlation of .039 between effect size and year of publication. This pattern did not occur at the elementary level. Studies before and after 1975 were virtually the same, 0.44 and 0.39 respectively.

Some studies examined dependent measures other than achievement test scores. Twelve studies measured the effect of CBE on student attitudes toward the course content. The average effect was only slightly positive, 0.08. More significantly, five studies measured students' attitudes

toward computers after either computer-based education or conventional instruction. Exposure to CBE increased attitudes toward computers by 0.48 standard deviations, a fairly large increase.

Discussion

Meta-analysis has underscored the very positive record of computer-based education in elementary and secondary schools. CBE has shown itself to be generally effective in a variety of settings. Achievement test scores were especially improved by computer-assisted instruction. Computer-enrichment programs at the secondary level were not very effective; but computer-managed courses were more successful at the high school level than at the elementary level.

There is reason to be very optimistic about the uses of computers in education. In addition to the positive record of past accomplishment, advances in software and hardware promise continuous innovation and hopefully future improvement. The gains in secondary school effect sizes over the years suggests that technological improvements may have measurable influence on student performance. Finally, exposure to CBE seems to encourage students to think favorably of the computers they must inevitably work with in our society. Therefore, learning through computers, not just about computers, offers important benefits for the attitudinal and intellectual growth of students in a technological world.

References

Burns, P. K. (1981). A quantitative synthesis of research findings relative to the pedagogical effectiveness of computer-assisted mathematics instruction in elementary and secondary schools. Dissertation Abstracts International, 42, 2946A. (University Microfilms No. 81-28,378)

Hartley, S. S. (1978). Meta-analysis of the effects of individually paced instruction in mathematics. Dissertation Abstracts International, 38, 4003A. (University Microfilms No. 77-29,926)

Kulik, J. A., Bangert, R. L., & Williams, G. W. (1983). Effects of computer-based teaching on secondary school students. Journal of Educational Psychology, 75, 19-26.